

# 27 Years Ago at MSC

## MSC tests in 1970 show water, oxygen available in lunar soil

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Ten employees of the NASA Manned Spacecraft Center have applied for a joint patent on a simple and practical device and process for recovering water and its constituent elements, by hydrogen and oxygen, from lunar soil.

The device is based on a chemical process using hydrogen and solar energy to reduce oxides containing iron, which are constituents of lunar soil, to produce water vapor, which can in turn, be electrolyzed to yield oxygen and hydrogen.

Samples of lunar material returned by the Apollo 11 and 12 astronauts contain significant proportions of an iron-titanium oxide called ilmenite.

The apparatus described in the patent application uses a mirror to focus the sun's rays on a container of lunar soil, heating the soil to between 600 and 1,300 degrees Centigrade. Hydrogen is then introduced into the container and reduces oxygen atoms present in the ilmenite to form steam. The steam is passed through an electrolysis cell which separates the constituent elements of oxygen and hydrogen.

The hydrogen used in the reaction must be supplied initially from Earth, but may be recirculated a number of times to produce more oxygen.

The chemical process has been tested in a laboratory at the Manned Spacecraft Center using simulated lunar soil and has been found feasible. The simulated lunar soil was pro-

duced in MSC's Lunar Receiving Laboratory by grinding and mixing the proper proportions of a basalt from Hawaii and ilmenite, obtained from Canada.

The patent application notes that while neither water nor uncombined oxygen has been found on the lunar surface, both can be produced from lunar resources, offering the potential of supporting lunar exploration as well as broader space exploration. Oxygen, for example, could be used not only to support life, but also as a propellant for space vehicles.

Calculations show that with the hydrogen process, 100 pounds of lunar soil would yield nearly a pound of water; and if the iron-bearing oxides are first concentrated magnetically the yield increases to nearly 14 pounds of water from 100 pounds of lunar material.

A number of other chemical reagents are being considered in addition to hydrogen. Flourine, for example provides a greater yield of oxygen, but requires a more complicated process and does not yield water directly.

The hydrogen technique and the fluoride technique for recovering oxygen from lunar soil are being investigated further at the Manned Spacecraft Center and at NASA's Lewis Research Center in Cleveland.

MSC employees named as co-inventors of the hydrogen production process and related apparatus are David S. McKay, Everett K. Gibson, Patrick Butler, Jr., Norman H. Chaffee, Edward I. Chimenti, Alfred P. Sanders, Andre J. Meyer, Hoyt McBryar, T.R. Wellman, and Robin Brett.



JSC Photo S70-53864  
Dr. W.R. Downs, left, technical assistant for advanced systems, the BRN Chemical Technician Fred Harper, center, and Dewayne Casten monitor water yield of a sample in the Materials Composition Test Lab operated by MSC at Ellington Air Force Base.

### Postscript

According to Norman Chaffee, one of the members of the team that worked on this process, the study and experimental evaluation of techniques for producing liquid water from lunar surface materials was a project that at the time seemed to have important near-term application, as NASA and JSC were in the middle of a spectacularly successful lunar landing and exploration program. "I got involved because I'm a chemical engineer and was familiar with chemical process principles and technology," said

Chaffee, who is retired but in working part time in Public Affairs' Education and Information Services Branch. "We actually successfully demonstrated a candidate process using the mineral ilmenite, and tried to patent it. Although our NASA patent attorney, Russ Schlorff, worked really hard for us we weren't granted the patent because the process was not sufficiently unique for terrestrial applications, and the U.S. Patent Office would not issue a patent for a process application on the Moon. Be that as it may, this was one of the assignments I most enjoyed during my career."

## Yeager recreates sound barrier-breaking flight on 50th anniversary

Renowned pilot Chuck Yeager recreated the historic flight in which he became the first person successfully to fly an aircraft faster than the speed of sound last month on the golden anniversary of that seminal event.

Yeager's flight in 1947 has been called "the greatest achieve-

ment since the first successful flight of the Wright Brothers."

On Oct. 14, exactly 50 years after the event, Yeager recreated the milestone flight in an F-15 fighter jet over California's Mojave Desert. The reenactment coincided with activities to commemorate the anniversary at Edwards Air Force Base, Calif.,

including the unveiling of a "50th anniversary of supersonic flight" stamp by the U.S. Postal Service.

Beginning in 1946, two XS-1 experimental research aircraft (later redesignated X-1s) conducted pioneering tests at Muroc Army Air Field (now Edwards Air Force Base) in California to obtain flight data on

conditions in the transonic speed range. These early tests culminated in the first piloted flight faster than Mach 1.0, the speed of sound.

The XS-1, the first high-speed aircraft built purely for aviation research purposes, was designed largely in accordance with specifications provided by the National

Advisory Committee for Aeronautics, now NASA, paid for by the Army Air Forces, and built by Bell Aircraft. The NACA X-1 procedures and personnel helped lay the foundation of America's space program and provided a basis for American aviation supremacy in the latter half of the 20th Century.

## Gilruth Center News

**Hours:** The Gilruth Center is open from 6:30 a.m.-10 p.m. Monday-Thursday, 6:30 a.m.-9 p.m. Friday, and 9 a.m.-2 p.m. Saturday.

**Sign up policy:** All classes and athletic activities are first come, first served. Sign up in person at the Gilruth Center and show a yellow Gilruth or weight room badge. Classes tend to fill up two weeks in advance. Payment must be made in full, in exact change or by check, at the time of registration. No registration will be taken by telephone. For more information, call x30304.

**Gilruth badges:** Required for use of the Gilruth Center. Employees, spouses, eligible dependents, NASA retirees and spouses may apply for photo identification badges from 7:30 a.m.-9 p.m. Monday-Friday; and 9 a.m.-2 p.m. Saturdays. Cost is \$10. Dependents must be between 16 and 23 years old.

**Hatha Yoga:** A stress relieving, stretching and breathing exercise routine to unite body, mind and spirit. Classes meet from 5:30-6:30 p.m. Thursdays. Cost is \$40 for eight weeks.

**Nutrition intervention program:** A six-week program to learn more about the role diet and nutrition play in health, including lectures, private consultations with a dietitian and blood analysis. Program is open to all employees, contractors and spouses. For more information call Tammie Shaw at x32980.

**Defensive driving:** One-day course is offered once a month. Pre-registration required. Cost is \$25. Call for next available class.

**Stamp club:** Meets at 7 p.m. every second and fourth Monday in Rm. 216.

**Weight safety:** Required course for employees wishing to use the weight room will be offered from 8-9:30 p.m. Call for next available class. Pre-registration is required. Cost is \$5. Annual weight room use fee is \$90. Additional family members are \$50.

**Exercise:** Low-impact class meets from 5:15-6:15 p.m. Mondays and Wednesdays. Cost is \$24 for eight weeks.

**Aikido:** Introductory martial arts class meets from 5:15-6:15 p.m. Tuesday and Wednesday. Cost is \$35 per month. New classes begin the first of each month.

**Step/Bench aerobics:** Classes meet from 5:15-6:15 p.m. Monday, Tuesdays and Thursdays. Cost is \$32 for eight weeks. Kristen Taragzewski, instructor.

**Ballroom dancing:** Beginner classes meet from 7-8:15 p.m. Thursdays. Intermediate and advanced classes meet from 8:15-9:30 p.m. Cost is \$60 per couple.

**Country and western dancing:** Beginner class meets 7-8:30 p.m. Monday. Advanced class (must know basic steps to all dances) meets 8:30-10 p.m. Monday. Cost is \$20 per couple.

**Fitness program:** Health Related Fitness Program includes a medical screening examination and a 12-week individually prescribed exercise program. For more information call Larry Wier at x30301.

**Gilruth Home Page:** Check out all activities at the Gilruth online at: <http://www4.jsc.nasa.gov/ah/exceaa/Gilruth/Gilruth.htm>

## Ticket Window

The following discount tickets are available for purchase in the Bldg. 11 Exchange Store from 10 a.m.-2 p.m. Monday-Thursday and 9 a.m.-3 p.m. Friday and in the Bldg. 3 Exchange Store from 7 a.m.-4 p.m. Monday - Friday. For more information call x35350 or x30990.

**Texas Renaissance Festival:** adults, \$12; children 5-12, \$5.50.

**EAA Christmas Dinner/Dance:** Dec. 13, \$25 per person

**Astroworld:** \$19 Blue Light Special, valid only in Houston, through Jan. 4.

**Moody Gardens:** Tickets are \$9.50 for two of four events.

**Seaworld:** Adult \$27.25; children (3-11) \$18.25.

**Space Center Houston:** Adult \$8.95; children (4-11) \$6.40 JSC civil service employees free.

**Movie discounts:** General Cinema, \$5.25; AMC Theater, \$4.50; Sony Loew's Theater, \$4.75.

**Shirts:** JSC logo T-shirt, \$10, polo style, \$23; International Space Station logo golf shirts, \$26 and \$28.

**Stamps:** Book of 20, \$6.40.

**1998 Franklin Planner** replacement refill orders being taken now.

**Sweetwater Pecans:** Orders are being taken now; cost is \$5.75 per pound.

**Metro passes:** Tokens and value cards available.

**Book available:** *Suddenly Tomorrow Came: A History of Johnson Space Center.*

**Upcoming events:** EAA Spring Break Ireland Trip: March 21-29, \$1,399 per person, double occupancy (\$200 deposit per person, final payment due Jan. 21).